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Assessment of Resource Use Efficiency in Tomato Production in Ayedire Local Government, Osun State

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Abstract

The study explored gender and resource use efficiency in tomato production in Ayedire Local Government Area, Osun State, Nigeria. Using a multistage random sampling technique, 120 tomato farmers were selected and interviewed with detailed questionnaires. Data were analyzed using descriptive statistics, gross margin analysis, and the stochastic frontier model. Findings revealed that the majority of farmers were male (63.3%), married (74.6%), and had a mean age of 42 years. Most farmers (66.4%) were educated, with an average household size of nine persons and a farm size of 3.24 hectares. Farmers had an average of 12 years of farming experience, though only 14.2% had access to extension services. Despite the weak institutional framework, tomato farming was profitable, with indicators such as the Rate of Return on Investment (0.75), Earning per Naira Invested (1.74), and Rate of Return on Fixed Cost (5.96) showing strong returns. Resources like seeds, farm size, labor, and herbicides were underutilized, while fertilizers and fungicides were overutilized. Key determinants of resource use efficiency included age, education, access to credit, and extension services. Major constraints were pests, perishability, weather conditions, poor storage, and high seed costs. The study recommends promoting female participation in tomato production through gender-sensitive policies, enhancing access to training and technology, and encouraging the formation of women's farmer groups to improve knowledge sharing and resource access.

Keywords: Assessment, Resource, Use, Efficiency, Tomato, Production

1. Introduction

Tomato is an important vegetable crop that is widely cultivated all over the world (FAO, 2015b). In many developing countries, tomato cultivation is a major source of income for small-scale farmers, especially women (FAO, 2015c). Women have been reported to play a crucial role in farming, processing, and marketing and it is estimated that over 60 percent of all agricultural production, processing, and marketing activities were carried out by women (Yusuf, 2015). The issue of gender differences in relation to farm productivity in subsistence farming has been of special interest from the standpoint of public policy in developing countries (Kabeer, 2016). Women are key stakeholders in agriculture, yet they face numerous formidable obstacles (Sisay, 2016). Access to productive resources/inputs is an obstacle to agricultural growth in Africa, thus access to productive resources such as land, modern inputs, technology, education and financial services is a critical determinant of agricultural productivity (FAO, 2015a). Resource use efficiency is an important aspect of agricultural productivity that refers to the amount of output obtained per unit of input used. Therefore, the role of rural women in agricultural development draws not only the attention of the academics but also the policy makers. The issue of gender in agriculture has had an increasing interest for many researchers and investigators over the years and across the globe because of the debate on the role of women in economic development, Thus the analysis of women participation in agricultural activities such as irrigated and non - irrigated vegetable production is important and cannot be over emphasized in their contribution to the Gross Domestic Product (GDP) (Karim, et al., 2016). Across Sub-Saharan Africa, several

empirical studies have found that female farmers have lower yields than male farmers (Larson, et al., 2015). Their access to technology, information, and agricultural extension tends to be more limited compared to men (Bravo-Monroy, et al., 2016). In growing crops, women are more prone to be constrained in their access to inputs, resulting in lower levels of fertilizer, labour, and other inputs than is optimal (Cadzow, 2016).

Nigeria is an agrarian country with about 70 percent of the population engaged in agricultural production (Yusuf et al., 2016). However, the efficiency of tomato production is often affected by gender disparities in access to resources such as land, credit, inputs, and labour (Oladeebo and Fajuyigbe, 2017). However, a body of empirical evidence from many different countries shows that female farmers are just as efficient as their male counterparts, but they have fewer resources, resulting in inadequate use of resources, limited alternatives and low income so they produce less (Yusuf, 2015). Ayinde et al., (2013a) opined that, it is of importance to have strategy to put men and women's concerns and experiences at the centre of research design, implementation, monitoring, and evaluation. Bridging the gap in access to technology between men and women, we could increase productivity; Ayinde et al., (2013b) further affirmed that technological adoption among male and female farmers is crucial to improving the productivity. The gendered nature of resource access and use can have a significant impact on resource use efficiency in tomato production. Furthermore, there are gender differences in levels of efficiency in resource management in agricultural production (Nwaru, 2013). Invariably, this could affect technology adoption, utilization and outputs of various farmers groups. This study therefore examined the gender-related factors influencing the resource use efficiency in smallholder tomato farms in Ayedire Local Government Area of Osun State, Nigeria.

Tomato production is a critical component of smallholder farming systems, contributing significantly to food security, income generation, and agricultural development in Nigeria. Despite its importance, the productivity of tomato farming in many regions, including Ayedire Local Government, Osun State, remains suboptimal. This challenge is attributed to inefficiencies in the use of key production resources such as land, labor, capital, and inputs. Studies have shown that resource use inefficiency is a common issue in Nigerian agriculture, often resulting from limited access to improved technologies, inadequate knowledge of best practices, and infrastructural deficits (Umeh, et al., 2021). Efficient utilization of resources is crucial for enhancing productivity and profitability in tomato production. However, empirical evidence on the resource use efficiency of tomato farmers in Ayedire Local Government is scant. Previous studies in other regions suggest that inefficiencies in resource use are influenced by socio-economic factors, access to credit, and extension services, as well as market dynamics (Yakubu et al., 2019; Adetunji & Rauf, 2020). Without a clear understanding of these dynamics in the study area, efforts to improve productivity may remain ineffective.

Chukwuji and Oyaide (2005) reported that income per head and technical efficiency were not significantly different for men and women, Ohajianya and Onyenweaku (2011) reported from their profit function analysis that there were no significant differences in economic efficiencies of male and female rice farmers in Ebonyi State of Nigeria. None of these reports considered tomato production which is a major vegetable crop of great importance in the State. The beauty of empirical studies using the stochastic frontier model to estimate production efficiency among male and female tomato farmers in this part of Nigeria gives further justification to this attempt.

This research aims to fill this gap by assessing resource use efficiency in tomato production in Ayedire Local Government, Osun State. The study will identify efficiency levels, explore the factors influencing resource use, and provide recommendations for improving productivity and farmers' livelihoods. This aligns with the need for evidence-based strategies to address inefficiencies and promote sustainable agricultural practices (Clanton, 2021).

The main objective of this study was to investigate the gendered nature of resource use efficiency in tomato production in Ayedire Local Government Area of Osun State, Nigeria. The specific objectives of the study include:

1) Describe the socio-economic characteristics of the tomato farmers.
2) Assessing the gendered patterns of resource access and use in tomato production.
3) Estimate the profitability of tomato production in the study area.
4) Analyze the factors that influence resource use efficiency in tomato production, with
5) A focus on gender-related factors.
6) Identify the constraints to tomato production in the study area.

2. Materials and Methods

2.1 The Study Area

The study was conducted in Ayedire Local Government Area of Osun State. Osun State is located in Southwestern Nigeria and its geographic coordinates are approximately 7.5 degrees North latitude and 4.5 degrees East longitude. The state is one of the six states comprising south-western Nigeria and it was created in 1991 from the Eastern part of Oyo State with its capital located in Osogbo. The state has a land area of 9251 km2 (about 0.93 million hectares) and a population of about 4 million people (NPC, 2006). The state is situated entirely within the tropics and is suited to produce permanent crops such as cocoa, coffee, and oil palm and arable crops such as maize,

yam, cassava, and rice. The annual rainfall is between 1000 mm and 1500mm with daily temperatures ranging between 280 C and 300 C. The economy of Osun State is largely based on agriculture, with the state being a significant producer of crops such as cocoa, palm oil, cassava, yam, maize, and vegetables. The State also has a growing presence in the mining sector, with significant deposits of gold, tantalite, granite, and talc.

Ayedire Local Government Area is one of the 30 Local Government Areas in Osun State. It is in the northern part of the state and shares borders with Oyo State to the North and Kwara State to the East. Ayedire Local Government Area has an area of 1,077 square kilometers and a population of over 60,000 people. The local government area is divided into several towns and villages, including Ile Ogbo, Akindele, Gbongan, Obaagun, Aba Igbira, Kuta, and Aba Nla. The major occupation of the people is farming, and the area is known for its crop production. Overall, Ayedire Local Government Area is vibrant and culturally rich part of Osun State, with a strong focus on agriculture and a growing infrastructure.

Figure1. Map showing the location of Ayedire Local Government Area within Osun State.
Source: Wikipedia.org

2.2 Sampling Technique

Three-phase multistage sampling method was used for the study. The first stage involved the purposive selection of Ayedire Local Government area based on the a priori knowledge that the LGAs is producing tomatoes in both the rainforest and savannah agro-ecologies of Osun State and both men and women are actively involved in it. The second stage involved a random selection of Six (6) communities from Ayedire Local Government Areas. The last stage involved the selection of 20 tomato farmers including men and women household heads from each of the Six (6) communities using the snowball technique. This gives a total of 120 tomato farmers.

2.3 Data Analysis

Data for analysis were generated primarily using interview scheduled and structured questionnaires administered to one hundred and twenty (120) respondents selected for the study. Data analysis was achieved through the use of descriptive statistics, budgetary analysis, and Cobb-Douglas stochastic frontier production function

2.4 Analytical Technique

Data for the study were analyzed using both descriptive and inferential statistics. Objectives (i) and (ii) were analyzed using descriptive statistics such as mean, percentages and frequency distribution. Objective (iii) was analyzed using Budgetary Analysis Technique. Objective (iv) was analyzed using Cobb-Douglas stochastic frontier production function

2.5 Model Specifications

Budgetary Analysis was used to analyze this objective. In order to know the cost implications, returns, and profit on tomato production, this technique was used to compute the cost and returns in tomato production in the study area. The budgetary analysis (Gross Margin Analysis) was used by Henri-Ukoka et.al.,(2015) to analyze the Net Farm Income, Gross Margin, and Cost-Benefit Ratio. The budgetary technique which estimates the financial

outcome and profitability of farm enterprise was used to determine and analyze the cost and returns to factors of production of the tomato farmers.

The mathematical model is given as:

$$GM = \sum_{i=1}^{n} P_i Q_i - \sum_{j=1}^{m} C_j X_j \dots\dots\dots\dots\dots\dots (1)$$

Where:
GM = Farm Gross Margin (₦)
Pi = Unit farm gate price of output i (₦)
Q = Quantity of output for crop; (kg)
Cj = Unit price of variable input (₦)
Xj = Quantity of variable input j
i = Crop and n is the total number of cultivated crops
j = Variable input and m is the total number of the variable input used in the farm enterprise
Thus,

Gross Margin (GM) = TR – TVC .....(2)

TR = Price X Quantity
TC = TFC + TVC
GM = TR – TVC
NI = GM – TFC
Where,

TR = Total Revenue
TVC = Total Variable Cost
NI = Net Income
TC = Total Cost
TFC = Total Fixed Cost.
And,
Gross Ratio = TR/TC

Cobb-Douglas stochastic frontier production function

Several studies from both developing and developed countries have used the Cobb Douglas functional form to analyze farm efficiency (Coelli, 1996).

The model is represented as:

Y = f(X1, X2, X3, X4 …X6+ Vi- Ui) …. ……. (3)

This is defined as follows:

InY1 = bo + b1InX1 + b2InX2 + b3InX3 + b4InX4 + b5InX5 + b6InX6 + Vi-Ui……...(4)

Where;
In = Logarithm to base e
Yi = Output of Tomato (Kg)
X1= Age (Years)
X2 = Marital Status
X3 = Household Size (Number)
X4 = farm size (Ha)
X5 = Tomato seeds (Kg)
X6 = labour (Man days)
X7 = fertilizer (Kg)
X8 = capital (Naira)
X9 = other inputs (Kg)
Vi = a symmetric error term which accounts for random variations in output due to factors beyond the control of the farmer.

bo, b1, b2, b3, b4, b5 and b6 are regression parameters to be estimated

Ui = a non- negative random variable representing inefficiency in production relative to the stochastic frontier. In order to determine the factors contributing to the technical efficiency the following model was formulated and estimate jointly with equation (2) in a single stage by the methods of maximum likelihood using the computer program

FRONTIER 4.1 (Coelli, 1996):

TEi = 0 + 1Z1 + 2Z2 + 3Z3 + 4Z4 +… +10Z10

Where; TEi = the technical efficiency of the farmer
Z1 = ownership of land (Ha)
Z2 = household size (number)
Z3 = membership of cooperative/farmers' associations (number)
Z4 = contact with extension agent (number)
Z5 = age (years)
Z6 = marital status (dummy variable; 1 for married, 0 otherwise)
Z7 = Educational status (number of years spent in school)
Z8 = access to credit (dummy variable; 1 for access, 0 otherwise)
Z9 = farming experience (years)
Z10 = farm size (Ha)
0 = the intercept 1, 2, 3, 4, 5,……..10 are parameters to be estimated.

3. Results and Discussion

3.1 Socio-economic characteristics

The socio-economic characteristics of the respondents considered were gender distribution, age, marital status, family type, household size, farm size, educational status, years of experience, primary occupation, access to extension services, source of capital, experience in pigeon pea production, membership of cooperative associations, access to extension services, system of cropping, planting variety, pigeon pea improved variety, and disease resistant. The study recognizes and gives equal consideration to both genders during the data collection. The tomato farmers were predominantly males in the study area. The result shows that the majority (63.3%) of the tomato farmers were males, while the remaining (36.7%) were females during the period under consideration. The gender distribution of the tomato farmers indicated that the farming activities are less attractive to female's fold due to the energy-demanding nature of manual farm work. The age of tomato farmers varied between a minimum of 23 years and a maximum of 60 years. The mean age was 42 years, which simply implies that tomato farmers in this region were still in the economically active period of their lives. Significantly, this will improve their productivity, profitability, and efficiency of agricultural labour use. This equally agreed with many other findings that the mean age of farmers in Southwest, Nigeria is between 40 and 50 years. In Sekumade et al., (2014) findings, mean ages of 46, 50.5, and 45.8 years were recorded for farmers in Ekiti, Osun, and Oyo States respectively. The result showed that 40.1% of the tomato farmers who were predominantly males were aged above the mean age of 42 years while only about 26.3% of them, predominantly males, were aged below the mean age of 42 years in the study area. This generally implies that tomato farmers in this study area were adults but still active physically and economically. If properly harnessed, the age of tomato farmers in this study area will contribute to their efficiency and optimal performance.

The distribution of the tomato farmers by marital status showed that the majority (74.6%) were married and still living with their spouses during the period of this study. The percentage of unmarried or single tomato farmers who were predominantly males was (18.9%) indicating that only an infinitesimal population of the tomato farmers were still unmarried at the time of this study. It was also revealed that very minute populations (0.8%) of the tomato farmers were divorced at the period of this finding, while a small fraction of the farmers (4.1%) were widowed. The study clearly shows the very low level of the divorced situation, as only one (1) farmer constituting (0.8%) of the entire tomato farmers' population was divorced. This higher percentage of married tomato farmers in this study area shows the degree of socio-cultural and religious values that place importance on marriage. This could enhance efficiency in their tomato production with better economic opportunities. These results agreed with Oyekale et al., (2012) whose findings indicate that most rural farmers were married and living together with their spouse. The distribution of the tomato farmers by family type showed that the majority (63.9%) practiced polygamy with more than one wife in their households. While the remaining (34.1%) were practicing monogamy with only one wife in their households. This implies that tomato farmers in this study area are adherent of the Islamic faith with cultural support for many wives. The family or household size varied between a maximum of (18) people in one household and a minimum of (4) people with a mean of (9) persons per household. The distribution shows that the majority representing about (49.2%) of the tomato farmers have a family size between 6 and 10 persons. This simply implies that there were more people within the family or household in the study area. This result can be traced to the type of marriage practices and socio-cultural beliefs of the tomato farmers in the study area.

The result revealed that only (22.1%) of the tomato farmers had below (5) persons in their households while only (28.7%) of them had above Ten (10) persons in their households. This result implies the availability of family labour to the average farming households for their farming and economic activities. Obviously, this will reflect in the size of their farms and their scale of production. The average farm size in Nigeria according to the FAO, (2013) is 0.53

hectares for smallholders and 3.14 hectares for large farms. The maximum farm size of smallholder farmers is 1.7 hectares, and a large farm is 14.7 hectares. This study shows that tomato farmers operated on a medium scale of operations. This was shown by the mean farm size of 3.38 hectares, implying that the tomato production in the study area was characterized by medium scales of production as the majority (54.1%) of the tomato farmers cultivated around the mean farm size. This large scale of operation will enhance the production capacity in relation to the tomato output coming from this region. Because it is assumed that the higher the farm size, the higher the total outputs from the farm, and the smaller the farm size, the lower the output from the farm. The result also showed that the majority (54.1%) of the tomato farmers cultivated between 1 and 5 hectares of farmland, and about (27.8%) of the tomato farmers operated between 6 and 10 hectares of land. The few remaining (16.4%) of the tomato farmers operated on above 10 hectares of land.

The distribution of the tomato farmers according to their educational status showed that the majority (64.8%) of the tomato farmers were educated as they had one form of education or the other ranging from primary, secondary, and tertiary to vocational education including other forms of professional training. Only very few (33.6%) of the tomato farmers had no formal education at all. It significantly implies a high rate of literacy among the tomato farmers in this region. Invariably, this contributes positively to their technical and economic efficiency due to their ability to read instructions and accustomed to new information on farming activities. Accordingly, the Majority (39.3%) of the tomato farmers claimed to have secondary education. It was also observed that about (14.8%) of the tomato farmers claimed to have primary Education. Only (10.7%) of them had tertiary education. This is in line with *Okorie et al.,* (2016) who reported that education is an important factor that can influence small-scale farmers to adopt new innovations and research findings related to their area of production.

The years of farming experience varied between a minimum of two (2) years of experience and a maximum of thirty-five (35) years of experience with a mean of 18 years. The distribution of the tomato farmers according to their farming experience shows that only about (24.5%) of the tomato farmers had less than (10) years of farming experience. Only (28.7%) of the tomato farmers had farming experience of more than (20) years and the majority (46.8%) of them had farming experience between (11) and (20) years. This implies that the tomato farmers have many years of farming experience. This may be reflected in their productivities and efficiency of production including the level of output/hectare. The primary occupation of the respondents is tomato farming as the majority (63.9%) claimed to do this. About (9.8%) of the farmers were artisans involved in one form of work or the other. About (21.3%) of the farmers claimed to have been involved in other primary occupations such as driving. while only (3.3%) of them have civil service as their major primary occupation. The outcome of this study indicated that about (62.5%) of the tomato farmers had access to extension agent services forming the majority. While only a few of the tomato farmers accounting for (37.5%) had no access to the services of extension agents in this study area. This implies that tomato farmers in the study areas had good access to the services of extension agents. The majority (53.3%) of the tomato farmers claimed to have been denied access to credit facilities for their tomato farming activities while only (46.7%) of the tomato farmers had access to credit. This implies poor access to credit facilities or probably not reaching the main targeted farmers in the rural communities. This unavailability of credit facilities had discouraged majority of the respondents from engaging in agricultural productive activities that could boost production within the study area as opined by Oyinbo and Olaleye (2016).

Despite all the different intervention programs of the government on Agricultural finance, many farmers were yet to have access to credit facilities for their farming operations. The few (46.7%) of the tomato farmers that had access to credit facilities claimed to have sourced them from money lenders (9.0%), Commercial Banks (9.0%), Microfinance Bank (11.5%), Cooperative Society (18.2%) and Family/Friends (1.8%). This result shows that the tomato farmers depend largely on cooperative societies for their credit facilities in the study area. This implies that cooperative societies are playing a critical role by contributing to agricultural finance in the study area.

Table 1. Socio-Economic Characteristics of the Respondents

Characteristics	Frequency	Percentage	Mean
Gender:			
Male	76	68.3	
Female	44	36.7	
Age (Years):			
Between 21 – 30	16	13.3	
Between 31 – 40	41	34.2	
Above 40	63	52.5	42
Marital Status:			
Married	93	74.6	
Single	23	18.9	
Divorced	1	0.8	
Widowed	5	4.1	
Family Type:			
Monogamy	42	34.1	
Polygamy	78	63.9	
Household Size			
Less than 5 Persons	27	22.1	
Between 6 -10	59	49.2	9
Above 10 Persons	34	28.7	
Farm Size:			
Less than 5 hectares	65	54.1	3.38
Between 6 – 10 hectares	31	27.8	
Above 10 hectares	22	18.1	
Education Status:			
No formal Education	41	33.6	
Primary	18	14.8	
Secondary	48	39.3	
Tertiary	13	10.7	
Years of Farming Experience:			
Less than 10 Years	29	24.5	
Between 11 – 20	54	45	
Above 20 Years	37	30.5	
Primary Occupation:			
Tomato Farming	78	63.9	
Civil servants	4	3.3	
Artisans	12	9.8	
Others	26	21.3	
Access to Credit:			
No	64	53.3	
Yes	56	46.7	
Sources of Credit:			
Money Lender	11	19.6	
Commercial Bank	6	10.7	
Micro finance Bank	12	21.4	
Cooperative Society	20	35.7	
Family and friends	7	12.5	

Source: Field survey, 2024

3.2. Gender patterns of resource access and use in tomato production in the study area.

The gender analysis was used to describe the gender pattern of resource access and use in tomato production. The majority (50.8%) of the tomato farmers claimed that tomato production is a masculine task and as such is the sole business of men. About (49.2%) claimed that tomato production is for both males and females. While the remaining (1.7%) of the respondents perceived tomato production as a feminine task. This implies that tomato production is perceived to be a male occupation rather than female work because of the rigor and risk involved in its

production. The result of resource access and use by the tomato farmers were reported in the study area. Very few women have access to large hectares of land as the majority (19.2%) of the women in tomato production operated on less than 5 hectares in the study area. Only (8.3%) of female tomato farmers have access to and operate on above 10 hectares of land in the study area. On access to credit, only (16.7%) female tomato farmers have access to credit. This implies poor access to credit by most female tomato farmers. On access to Extension Agents, male tomato farmers which constituted the majority (40.0%) have access to extension agents compared to female tomato farmers with only (22.5%) of them having access to extension agents. On access to the market, the result shows that the majority (56.7%) of the male tomato farmers have access to the market while the minority (34.2%) of female tomato farmers have access to the market in the study area. There is poor access to other inputs such as fertilizer among both male and female tomato farmers in the study area. Only 7.5% and 4.2% of the male and female farmers respectively have access to other inputs.

Table 2. Gender distribution of Tomato Production

	Frequency	Percentage (%)
Masculine	61	50.8
Feminine	2	1.7
Both	59	49.2

Source: Field Survey, 2024.

Table 3. Gender Distribution of Resource Access and use in tomato production.

Variables		Frequency		Percentage (%)	
		Male	Female	Male	Female
Farm Size) =	< 5 ha	44	23	36.7	19.2
	(6-10) ha	23	11	19.2	9.2
	> 10 ha	20	10	16.7	8.3
Access to Credit					
	Yes	36	20	30.0	16.7
	No	40	24	33.3	20.0
Access to Extension Agents					
	Yes	48	27	40.0	22.5
	No	28	17	23.3	14.2
Access to Market					
	Yes	68	41	56.7	34.2
	No	8	3	6.7	2.5
Access to other inputs					
	Yes	9	5	7.5	4.2
	No	67	39	55.8	32.5

Source: Field Survey, 2024.

3.3. Estimate of Costs, Returns, and Profitability of Tomato Production

The budgetary technique was explored to estimate the profitability of tomato production. The result showed that an average tomato farmer realized about ₦523,600.00 per hectare as total revenue per hectare of tomato farm while the average yield of tomato was estimated at about 2,380kg/ha. (2.4 tons). Tomatoes are measured with a basket and one (1) basket is equivalent to 10kg. An average farmer spent ₦192, 856.00 per hectare as the total variable cost (TVC). These costs include the cost of land rent, land clearing, cost of purchase of seeds, planting, herbicides, pesticides, fertilizer, organic manure, weeding, and labour inputs. The total variable cost constituted 85% of all total cost incurred in tomato production. The estimated result showed that, about 70% of all the total variable cost was spent on labour inputs which include planting, weeding, spraying of pesticides, fertilizer applications and harvesting. The average fixed cost incurred by tomato farmer (₦129,447.09) constituted about 15% of the total cost (TC). It implies that, tomato production in the area required little capital investment on fixed cost. These fixed costs were majorly on cutlasses, hoes, knapsack sprayers etc. The result further revealed that, the gross margin of an average tomato farmer was ₦287,050.00 which imply that tomato production had desirable returns. Three business indicators were estimated, earning per Naira Invested (1.74), the Profit Ratio (0.74) and Rate of Return on Fixed Cost (3.07). A gross return per naira invested of ₦1.74 obtained showed that, for every one naira (₦1) invested in tomato farming, the farmer would earn ₦1.74. The profitability indicators show that tomato farming is a profitable enterprise in Ayedire Local Government Area of Osun State, Nigeria.

Table 4. Cost, Return and Profitability of Tomato Production per Hectare

Variable				₦
Revenue from 2,380 kilogram of Fresh Tomato (Per ha)				523, 600.00
Variable Cost	Unit	Price/Unit (₦)	Days	Cost (₦)
Land Clearing (Man/day)	5 Man	3,500	1	17,500.00
Cost of Seeds (Kg/ha)	4kg	4,000		20,060.00
Planting (Man/day)	5 Man	3,450	1	17,250.00.
Weeding (Man/day)	5 Man	3,200	1	15,966.00
NPK	2 Bags	10,500		27,066.00
Urea	2	9,500		23,062.00
Bags				
Herbicides/ Litres	10			15,972.00
Insecticides/ Litres	7	1,800		12,690.00
Fertilizer Application (Man/day)	4 Man	2,700	1	10,831.00
Cost of spraying Herbicides (Man/day) 2 Man		3,750	1	7,529.00
Cost of Spraying Insecticides (Man/day) 2 Man		3,750	1	7,360.00
Harvesting (Man/day)	3 Man	2,500	2	17,570.00
Total Variable Cost (TVC)				192,856.00
Fixed Cost				
Land lease				40,699.00
Depreciation on Cutlass				15,513.00
Depreciation on Knapsack Sprayer				29,010.00
Depreciation on Wheel Barrow				9,621.91
Depreciation on Hoe				12,603.00,
Total Fixed Cost				107,446.00
Total Cost				300, 302.00
Gross Margin				330,744.00
Profit				223,298.00
Profitability Indicators:				
EPI				1.74
PR				0.74
RRFC				3.07

Source: Field Data, 2024.
Note: EPI= Total revenue/Total Cost, PR = Profit/Total Cost, RRFC Gross Margin/Total Fixed Cost.

3.4. Factors Influencing resource use efficiency in Tomato production

The result of Maximum Likelihood Estimates (MLE) for the production frontier is presented in Table 5. The result showed that the estimated parameters of sigma-squared (σ^2) are 0.642 and 0.507 for male and female tomato farmers respectively. The values of Sigma-squared show a significant difference from zero at a 1% level of significance, which hypothesized the perfect goodness of fit of data with the Cobb- Douglas stochastic frontier model, and also the assumption of the composite error term was properly specified.

The generalized likelihood ratio statistics of 3.7 was obtained for male farmers while 6.4 was obtained for female tomato farmers. These ratios exceed the critical chi-square values at a 1% level of significance. The log-likelihood ratio value represents the value that maximizes the joint densities in the estimated model. Thus, the functional form that is, Cobb-Douglas used in this estimation is an adequate representation of the data. It was further revealed that the values of the gamma statistics were 0.52 and 0.73 for male and female farmers respectively. These indicate that 52% and 73% of the changes in the output of both male and female tomato farmers respectively are attributable to farmers' inefficiency factors. The result revealed that technical inefficiency effects were present in tomato production in the study area. The stochastic frontier model estimates Cobb-Douglas tomato production function based on six (6) basic input variables: labour, land (farm size), seed, herbicides, pesticides, and fertilizer with the help of maximum likelihood estimation techniques. The results show that area under tomato cultivation (land size), herbicide quantity applied, and labour quantity used were important in determining tomato production in the study area. Acreage under tomato cultivation (land size), the quantity of labour used, and herbicides quantity had positive

coefficients that were significant at a 1% level of significance for both male and female tomato farmers. Thus, increasing hectares under tomato production by 1% would increase tomato output by 0.837 and 0.651% for male and female tomato farmers respectively. Also, increasing the quantity of labour used by 1% would increase tomato output by 0.624 and 0.703% for male and female tomato farmers respectively and a 1% increase in herbicide usage will significantly increase the output of tomato by 0.708 and 0.873% for male and female tomato farmers respectively.

Table 5a. Maximum likelihood estimates of stochastic frontier production for Tomato production.

Variable Coefficients						
Variables	Male			Female		
	Coefficient	Std. Error	t-value	Coefficient	Std. Error	t-value
Constant (β_0)	7.305	0.6362	4.38***	4.621	0.6224	2.76**
Seed (X_1)	0.0611	0.014	1.18	0.374	0.013	1.02
Labour (X_2)	0.624	0.042	3.03***	0.703	0.086	3.42***
Fertilizer (X_3)	-0.086	0.049	-1.024	-0.127	0.046	-1.07
Farm size (X_4)	0.837	0.069	3.98***	0.651	0.082	4.01***
Herbicides (X_5)	0.708	0.087	3.63***	0.873	0.076	3.18***
Fungicides (X_6)	-0.251	0.096	-1.55	-0.008	0.098	-0.029
Variance parameters						
Sigma squared ($\sigma 2$)	0.642	0.201	4.72***	0.507	0.072	5.81***
Gamma (γ)	0.520	0.088	4.54***	0.730	0.420	3.00**
LR test		3.70			6.40	
log likelihood		-383.43			-465.81	

$\sigma^2 = \sigma v^2 + \sigma u^2$, $\gamma = \sigma u^2 / \sigma^2$, Std. - Standard *** Significant at 1%, ** Significant at 5%.

3.4.1. Result of Resources Use Efficiency of Tomato Production

The result of the resource use efficiency is presented in Table 5b. The result shows that the ratio of marginal value product (MVP) to marginal factor product (MFP) for fertilizer and fungicides is less than 1 for both male and female tomato farmers; this implies that the quantities of fertilizers and fungicides were over-utilized. This may be because of a lack of technical know-how or knowledge of the best practices in fertilizer and fungicide application. Any reduction in the usage of these inputs will lead to an increase in the output of tomatoes in the study area. Seeds of tomato, land, labour, and herbicide were under-utilized in tomato production activities of both male and female farmers in the study area. This may be a result of scarcity and high prices of improved seeds variety, labour, and herbicides especially during production periods, meaning that to increase the profitability of tomato production in the area, the level of such inputs utilized should be increased.

Table 5b. Determination of resource use efficiency in tomato production

Variables	Coefficients	MVP	MFC	MVP/MFC	Decision
Seeds (kg)	0.0611	1896.2	400	4.7405	under utilized
Labour (man/day)	0.624	6380.67	300	21.269	under utilized
Fertilizer (kg)	-0.086	- 5439.65	900	- 6.0441	over utilized
Farm size (Land) ha	0.837	4218.98	12.0	6.4321	under utilized
Herbicides (Litres)	0.708	1746.54	340	5.1369	under utilized
Fungicides (Litres)	-0.251	- 1832.60	250	- 7.3304	over utilized

Source: Field Survey, 2024

3.4.2. Determinants of technical efficiency:

After estimating technical inefficiency variables by using the single-stage estimation approach of the stochastic frontier model, identified the following significant determinant factors of technical efficiency of tomato producers.

Age: The age of the tomato farmers had a positive and significant (at a 5% significance level) effect on the technical efficiency of tomato production. It implies that as the age of the tomato farmers increases so does the technical efficiency increased.

Education Status: It is measured by the level of school education attained by the respondents, in this study education was a positive and statistically significant (at a 1% significance level) effect on technical efficiency. This might be due to, educated farmers were eager to disseminate technology that they were able to receive, interpret, and disseminate new information and improved technologies such as improved seeds, fertilizer, and pesticides.

Education also improved the unobserved labour quality and management capability of farmers, this, in turn, increased technical efficiency.

Access to extension Service: It is a dummy variable consisting of 1 and 0, It had a statistically significant and positive relationship with the technical efficiency of tomato production at a 5% level of significance. This implies that more access to extension services will increase the productivity of tomato production.

Access to Credit. It is a dummy variable indicating 1 if a farmer gets credit, and 0 otherwise. Table 5 revealed that access to credit has a favorable or positive effect on the technical efficiency of tomato producers at a 1% level of significance. Cash requirements for purchasing inputs on time (improved tomato seed, pesticides, additional labour force, and fertilizer) will result in the farmer being more efficient than the counterpart.

Table 5c. Determinants of Technical Efficiency

Variable	parameter	Coefficient	Std Error	z	p-value
Constants	β_0	5.3289	0.67323	5.212	0.0001
Gender	β_1	-0.6217	0.4328	0.532	0.1041
Age	β_2	0.4974**	0.3290	3.032	0.0010
Education Level	β_3	0.3219***	0.8320	4.091	0.0036
Farm Size	β_4	0.7145	0.5931	1.042	0.8532
Household Size	β_5	0.6219	0.4209	0.5432	0.3021
Access to Extension	β_6	0.9521**	0.5197	1.910	0.0042

Source: Field Survey, 2024. Note: **** (1%), ** (5%)

4. Conclusion and Recommendations

The study established that tomato farmers were mostly male, married, physically and economically active in age. They were experienced, educated, and efficient in their resource utilization for tomato production. Tomato production was highly profitable in the study area because the total revenue and total cost have a pristine difference, with a high profit ratio and earnings per naira invested (EPI). Age of the tomato farmers, household size, farm size, farming experience, practice of organic farming, pest infestation, and extension services contacts were the factors determining the resource use efficiency. Since the study revealed that most of the farmers in the study area were predominantly male. It is therefore recommended that female participation in tomato production should be encouraged by Implementing gender-sensitive agricultural policies and programs that specifically target female farmers. The study showed that there is a very weak institutional framework between tomato farmers and extension agents in the study area. Tomato farmers should have access to training, and improved technologies to enhance their productivity and resource use efficiency. Formation of women's farmer groups to facilitate knowledge sharing, resource pooling, and access to markets should be enhanced and encouraged to address gender disparities in land ownership and access to credit to ensure equitable opportunities for female farmers. Agricultural input supply centers should be established in Ayedire Local Government to ensure timely and affordable access to fertilizers, pesticides, and other essential inputs for tomato production. Use of climate-smart and sustainable agricultural practices to reduce input costs and enhance resource use efficiency should be promoted and practiced amongst Tomatoes Farmers in the study area. Training and support the farmers on processing and value addition of tomatoes, such as producing tomato paste, juice, or dried tomatoes, to increase income generation and reduce post-harvest losses should be encouraged in the study area. Access to electricity and energy-efficient technologies to support irrigation, processing, and storage of tomatoes should be provided and enhanced in the study area.

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